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<120> NUCLEIC ACID MOLECULES WHICH CODE FOR ENZYMES DERIVED FROM WHEAT AND WHICH ARE INVOLVED IN THE SYNTHESIS OF STARCH

<130> 514413-3849.1

<150> WO 99/58690

<151> 1999-11-18

<150> DE 198 20 608.9

<151> 1998-05-08

<150> 09/674,817

<151> 2000-11-06

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① ② <170> PatentIn version 3.1

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<212> DNA

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<222> (397) .. (1617)

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Ala Gly Lys Gly Val Gly Glu Val Cys Ala Ala Val Val Glu Ala Ala
20 25 30

95

tat gtc aat tat ttt cgc tgg gat aaa aaa gaa caa tac tct gag ttg	2513
Tyr Val Asn Tyr Phe Arg Trp Asp Lys Lys Glu Gln Tyr Ser Glu Leu	
615 620 625	
cac cga ttc tgc tgc ctc atg acc aaa ttc cgc aag gag tgc gag ggt	2561
His Arg Phe Cys Cys Leu Met Thr Lys Phe Arg Lys Glu Cys Glu Gly	
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ctt ggc ctt gag gac ttt cca acg gcc aaa cgg ctg cag tgg cat ggt	2609
Leu Gly Leu Glu Asp Phe Pro Thr Ala Lys Arg Leu Gln Trp His Gly	
645 650 655 660	
cat cag cct ggg aag cct gat tgg tct gag aat agc cga ttc gtt gcc	2657
His Gln Pro Gly Lys Pro Asp Trp Ser Glu Asn Ser Arg Phe Val Ala	
665 670 675	
ttt tcc atg aaa gat gaa aga cag ggc gag atc tat gtg gcc ttc aac	2705
Phe Ser Met Lys Asp Glu Arg Gln Gly Glu Ile Tyr Val Ala Phe Asn	
680 685 690	
acc agc cac tta ccg gcc gtt gtt gag ctc cca gag cgc gca ggg cgc	2753
Thr Ser His Leu Pro Ala Val Val Glu Leu Pro Glu Arg Ala Gly Arg	
695 700 705	
cgg tgg gaa ccg gtg gtg gac aca ggc aag cca gca cca tac gac ttc	2801
Arg Trp Glu Pro Val Val Asp Thr Gly Lys Pro Ala Pro Tyr Asp Phe	
710 715 720	
ctc acc gac tta cct gat cgc gct ctc acc ata cac cag ttc tcg	2849
Leu Thr Asp Asp Leu Pro Asp Arg Ala Leu Thr Ile His Gln Phe Ser	
725 730 735 740	
cat ttc ctc tac tcc aac ctc tac ccc atg ctc agc tac tca tcg gtc	2897
His Phe Leu Tyr Ser Asn Leu Tyr Pro Met Leu Ser Tyr Ser Val	
745 750 755	
atc cta gta ttg cgc cct gat gtt tga gag acc aat ata tac agt aaa	2945
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Lys Val Glu Asp Glu Gly Glu Glu Asp Glu Pro Val Ala Glu Asp Arg
35 40 45

Tyr Ala Leu Gly Gly Ala Cys Arg Val Leu Ala Gly Met Pro Ala Pro
50 55 60

Leu Gly Ala Thr Ala Leu Ala Gly Gly Val Asn Phe Ala Val Tyr Ser
65 70 75 80

Gly Gly Ala Thr Ala Ala Leu Cys Leu Phe Thr Pro Glu Asp Leu
85 90 95

Lys Ala Asp Arg Val Thr Glu Glu Val Pro Leu Asp Pro Leu Met Asn
100 105 110

Arg Thr Gly Asn Val Trp His Val Phe Ile Glu Gly Glu Leu His Asn
115 120 125

Met Leu Tyr Gly Tyr Arg Phe Asp Gly Thr Phe Ala Pro His Cys Gly
130 135 140

His Tyr Leu Asp Val Ser Asn Val Val Val Asp Pro Tyr Ala Lys Ala
145 150 155 160

Val Ile Ser Arg Gly Glu Tyr Gly Val Pro Ala Arg Gly Asn Asn Cys
165 170 175

Trp Pro Gln Met Ala Gly Met Ile Pro Leu Pro Tyr Ser Thr Phe Asp
180 185 190

Trp Glu Gly Asp Leu Pro Leu Arg Tyr Pro Gln Lys Asp Leu Val Ile
195 200 205

Tyr Glu Met His Leu Arg Gly Phe Thr Lys His Asp Ser Ser Asn Val
210 215 220

Glu His Pro Gly Thr Phe Ile Gly Ala Val Ser Lys Leu Asp Tyr Leu
225 230 235 240

Lys Glu Leu Gly Val Asn Cys Ile Glu Leu Met Pro Cys His Glu Phe
245 250 255

Asn Glu Leu Glu Tyr Ser Thr Ser Ser Lys Met Asn Phe Trp Gly
260 265 270

Tyr Ser Thr Ile Asn Phe Phe Ser Pro Met Thr Arg Tyr Thr Ser Gly

His Gln Phe Ser His Phe Leu Tyr Ser Asn Leu Tyr Pro Met Leu Ser
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Tyr Ser Ser Val Ile Leu Val Leu Arg Pro Asp Val
755 760

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Thr Ala Gly Lys Gly Val Gly Glu Val Cys Ala Ala Val Val Glu Val
15 20 25

gcg acg aag gcc gag gat gag ggg gag gag gac gag ccg gtg gcg gag 147
Ala Thr Lys Ala Glu Asp Glu Gly Glu Asp Glu Pro Val Ala Glu
30 35 40

gac agg tac gcg ctc ggc ggc gcg tgc agg gtg ctc gcc gga atg ccc 195
Asp Arg Tyr Ala Leu Gly Gly Ala Cys Arg Val Leu Ala Gly Met Pro
45 50 55 60

acg ccg ctg ggc gcc acc gcg ctc gcc ggc ggg gtc aat ttc gcc gtc 243
Thr Pro Leu Gly Ala Thr Ala Leu Ala Gly Gly Val Asn Phe Ala Val

65	70	75	
tac tcc ggc gga gcc aca gcc gcg	ctc tgc ctc ttc acg cca gaa		291
Tyr Ser Gly Gly Ala Thr Ala Ala	Ala Leu Cys Leu Phe Thr Pro Glu		
80	85	90	
gat ctc aag gcg gat agg gtg acg gag gag	gtt ccc ctt gac ccc ctg		339
Asp Leu Lys Ala Asp Arg Val Thr Glu Glu Val Pro Leu Asp Pro Leu			
95	100	105	
atg aat cgg act ggg aac gta tgg cat gtc ttc atc gaa ggc gag ctg			387
Met Asn Arg Thr Gly Asn Val Trp His Val Phe Ile Glu Gly Glu Leu			
110	115	120	
cag gac atg ctt tac ggg tac agg ttc gac ggc acc ttt gct cct cac			435
Gln Asp Met Leu Tyr Gly Tyr Arg Phe Asp Gly Thr Phe Ala Pro His			
125	130	135	140
tgc ggg cac tac ctt gat gtt tcc aat gtc gtg gtg gat cct tat gct			483
Cys Gly His Tyr Leu Asp Val Ser Asn Val Val Val Asp Pro Tyr Ala			
145	150	155	
aag gca gtg ata agc cga ggg gag tat ggt gtt ccg gcg cgt ggt aac			531
Lys Ala Val Ile Ser Arg Gly Glu Tyr Gly Val Pro Ala Arg Gly Asn			
160	165	170	
aat tgc tgg cct cag atg gct ggc atg atc cct ctt cca tat agc acg			579
Asn Cys Trp Pro Gln Met Ala Gly Met Ile Pro Leu Pro Tyr Ser Thr			
175	180	185	
ttt gat tgg gaa ggc gac cta cct cta aga tat cct caa aag gac ctg			627
Phe Asp Trp Glu Gly Asp Leu Pro Leu Arg Tyr Pro Gln Lys Asp Leu			
190	195	200	
gta ata tat gag atg cac ttg cgt gga ttc acg aag cat gat tca agc			675
Val Ile Tyr Glu Met His Leu Arg Gly Phe Thr Lys His Asp Ser Ser			
205	210	215	220
aat gta gaa cat ccc ggt act ttc att ggg gct gtg tcg aag ctt gac			723
Asn Val Glu His Pro Gly Thr Phe Ile Gly Ala Val Ser Lys Leu Asp			
225	230	235	
tat ttg aag gag ctt gga gtt aat tgt att gag tta atg ccc tgc cat			771
Tyr Leu Lys Glu Leu Gly Val Asn Cys Ile Glu Leu Met Pro Cys His			
240	245	250	
gag ttc aac gag ctg gag tac tca acc tct tct tcc aag atg aac ttt			819
Glu Phe Asn Glu Leu Glu Tyr Ser Thr Ser Ser Lys Met Asn Phe			
255	260	265	
tgg gga tat tct acc ata aac ttc ttt tca cca atg acg aga tac aca			867
Trp Gly Tyr Ser Thr Ile Asn Phe Phe Ser Pro Met Thr Arg Tyr Thr			
270	275	280	
tca ggc ggg ata aaa aac tgt ggg cgt gat gcc ata aat gag ttc aaa			915
Ser Gly Gly Ile Lys Asn Cys Gly Arg Asp Ala Ile Asn Glu Phe Lys			
285	290	295	300

act ttt gta aga gag gct cac aaa cgg gga att gag gtg atc ctg gat		963
Thr Phe Val Arg Glu Ala His Lys Arg Gly Ile Glu Val Ile Leu Asp		
305	310	315
gtt gtc ttc aac cat aca gct gag ggt aat gag aat ggt cca ata tta		1011
Val Val Phe Asn His Thr Ala Glu Gly Asn Glu Asn Gly Pro Ile Leu		
320	325	330
tca ttt agg ggg gtc gat aat act aca tac tat atg ctt gca ccc aag		1059
Ser Phe Arg Gly Val Asp Asn Thr Thr Tyr Tyr Met Leu Ala Pro Lys		
335	340	345
gga gag ttt tat aac tat tct ggc tgt ggg aat acc ttc aac tgt aat		1107
Gly Glu Phe Tyr Asn Tyr Ser Gly Cys Gly Asn Thr Phe Asn Cys Asn		
350	355	360
cat cct gtg gtt cgt caa ttc att gta gat tgt tta aga tac tgg gtg		1155
His Pro Val Val Arg Gln Phe Ile Val Asp Cys Leu Arg Tyr Trp Val		
365	370	375
380		
acg gaa atg cat gtt gat ggt ttt cgt ttt gat ctt gca tcc ata atg		1203
Thr Glu Met His Val Asp Gly Phe Arg Phe Asp Leu Ala Ser Ile Met		
385	390	395
acc aga ggt tcc agt ctg tgg gat cca gtt aac gtg tat gga gct cca		1251
Thr Arg Gly Ser Ser Leu Trp Asp Pro Val Asn Val Tyr Gly Ala Pro		
400	405	410
ata gaa ggt gac atg atc aca aca ggg aca cct ctt gtt act cca cca		1299
Ile Glu Gly Asp Met Ile Thr Thr Gly Thr Pro Leu Val Thr Pro Pro		
415	420	425
ctt att gac atg atc agc aat gac cca att ctt gga ggc gtc aag ctc		1347
Leu Ile Asp Met Ile Ser Asn Asp Pro Ile Leu Gly Gly Val Lys Leu		
430	435	440
440		
gtt gct gaa gca tgg gat gca gga ggc ctc tatcaa gta ggt caa ttc		1395
Val Ala Glu Ala Trp Asp Ala Gly Gly Leu Tyr Gln Val Gly Gln Phe		
445	450	455
460		
cct cac tgg aat gtt tgg tct gag tgg aat ggg aag tac cgg gac att		1443
Pro His Trp Asn Val Trp Ser Glu Trp Asn Gly Lys Tyr Arg Asp Ile		
465	470	475
475		
gtg cgt caa ttc att aaa ggc act gat gga ttt gct ggt ggt ttt gcc		1491
Val Arg Gln Phe Ile Lys Gly Thr Asp Gly Phe Ala Gly Gly Phe Ala		
480	485	490
490		
gaā tgt ctt tgt gga agt cca cac cta tac cag gca gga gga agg aaa		1539
Glu Cys Leu Cys Gly Ser Pro His Leu Tyr Gln Ala Gly Gly Arg Lys		
495	500	505
505		
cct tgg cac agt atc aac ttt gta tgt gca cac gat gga ttt aca ctg		1587
Pro Trp His Ser Ile Asn Phe Val Cys Ala His Asp Gly Phe Thr Leu		
510	515	520

gct gat ttg gta aca tat aat aac aag tac aat tta cca aat ggg gag	1635
Ala Asp Leu Val Thr Tyr Asn Asn Lys Tyr Asn Leu Pro Asn Gly Glu	
525 530 535 540	
aac aac aga gat gga gaa aat cac aat ctt agc tgg aat tgt ggg gag	1683
Asn Asn Arg Asp Gly Glu Asn His Asn Leu Ser Trp Asn Cys Gly Glu	
545 550 555	
gaa gga gaa ttc gca aga ttg tct gtc aaa aga ttg agg aag agg cag	1731
Glu Gly Glu Phe Ala Arg Leu Ser Val Lys Arg Leu Arg Lys Arg Gln	
560 565 570	
atg cgc aat ttc ttt gtt tgt ctc atg gtt tct caa gga gtt cca atg	1779
Met Arg Asn Phe Phe Val Cys Leu Met Val Ser Gln Gly Val Pro Met	
575 580 585	
ttc tac atg ggt gat gaa tat ggc cac aca aaa ggg ggc aac aac aat	1827
Phe Tyr Met Gly Asp Glu Tyr Gly His Thr Lys Gly Gly Asn Asn Asn	
590 595 600	
aca tac tgc cat gat tct tat gtc aat tat ttt cgc tgg gat aaa aaa	1875
Thr Tyr Cys His Asp Ser Tyr Val Asn Tyr Phe Arg Trp Asp Lys Lys	
605 610 615 620	
gaa caa tac tct gac ttg cac cga ttc tgt tgc ctc atg acc aaa ttc	1923
Glu Gln Tyr Ser Asp Leu His Arg Phe Cys Cys Leu Met Thr Lys Phe	
625 630 635	
cgc aag gag tgc gag ggt ctt ggc ctt gag gat ttt cca acg gcc gaa	1971
Arg Lys Glu Cys Glu Gly Leu Glu Asp Phe Pro Thr Ala Glu	
640 645 650	
cgg ctg cag tgg cat ggt cat cag cct ggg aag cct gat tgg tct gag	2019
Arg Leu Gln Trp His Gly His Gln Pro Gly Lys Pro Asp Trp Ser Glu	
655 660 665	
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Ile Tyr Val Ala Phe Asn Thr Ser His Leu Pro Ala Val Val Glu Leu	
685 690 695 700	
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Pro Glu Arg Thr Gly Arg Arg Trp Glu Pro Val Val Asp Thr Gly Lys	
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Pro Ala Pro Tyr Asp Phe Leu Thr Asp Asp Leu Pro Asp Arg Ala Leu	
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acc ata cac cag ttc tct cat ttc ctc aac tcc aac ctc tac ccc atg	2259
Thr Ile His Gln Phe Ser His Phe Leu Asn Ser Asn Leu Tyr Pro Met	
735 740 745	
ctc agc tac tca tcg gtc atc cta gta ttg cgc cct gat gtt tga	2304

Leu Ser Tyr Ser Ser Val Ile Leu Val	Leu Arg Pro Asp Val	
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Glu Asp Glu Gly Glu Glu Asp Glu Pro Val Ala Glu Asp Arg Tyr Ala		
35	40	45
Leu Gly Gly Ala Cys Arg Val Leu Ala Gly Met Pro Thr Pro Leu Gly		
50	55	60
Ala Thr Ala Leu Ala Gly Gly Val Asn Phe Ala Val Tyr Ser Gly Gly		
65	70	75
80		
Ala Thr Ala Ala Ala Leu Cys Leu Phe Thr Pro Glu Asp Leu Lys Ala		
85	90	95
Asp Arg Val Thr Glu Glu Val Pro Leu Asp Pro Leu Met Asn Arg Thr		
100	105	110
Gly Asn Val Trp His Val Phe Ile Glu Gly Glu Leu Gln Asp Met Leu		
115	120	125
Tyr Gly Tyr Arg Phe Asp Gly Thr Phe Ala Pro His Cys Gly His Tyr		
130	135	140
Leu Asp Val Ser Asn Val Val Val Asp Pro Tyr Ala Lys Ala Val Ile		
145	150	155
160		

Ser Arg Gly Glu Tyr Gly Val Pro Ala Arg Gly Asn Asn Cys Trp Pro
165 170 175

Gln Met Ala Gly Met Ile Pro Leu Pro Tyr Ser Thr Phe Asp Trp Glu
180 185 190

Gly Asp Leu Pro Leu Arg Tyr Pro Gln Lys Asp Leu Val Ile Tyr Glu
195 200 205

Met His Leu Arg Gly Phe Thr Lys His Asp Ser Ser Asn Val Glu His
210 215 220

Pro Gly Thr Phe Ile Gly Ala Val Ser Lys Leu Asp Tyr Leu Lys Glu
225 230 235 240

Leu Gly Val Asn Cys Ile Glu Leu Met Pro Cys His Glu Phe Asn Glu
245 250 255

Leu Glu Tyr Ser Thr Ser Ser Lys Met Asn Phe Trp Gly Tyr Ser
260 265 270

Thr Ile Asn Phe Phe Ser Pro Met Thr Arg Tyr Thr Ser Gly Gly Ile
275 280 285

Lys Asn Cys Gly Arg Asp Ala Ile Asn Glu Phe Lys Thr Phe Val Arg
290 295 300

Glu Ala His Lys Arg Gly Ile Glu Val Ile Leu Asp Val Val Phe Asn
305 310 315 320

His Thr Ala Glu Gly Asn Glu Asn Gly Pro Ile Leu Ser Phe Arg Gly
325 330 335

Val Asp Asn Thr Thr Tyr Tyr Met Leu Ala Pro Lys Gly Glu Phe Tyr
340 345 350

Asn Tyr Ser Gly Cys Gly Asn Thr Phe Asn Cys Asn His Pro Val Val
355 360 365

Arg Gln Phe Ile Val Asp Cys Leu Arg Tyr Trp Val Thr Glu Met His
370 375 380

Val Asp Gly Phe Arg Phe Asp Leu Ala Ser Ile Met Thr Arg Gly Ser

385 390 395 400

Ser Leu Trp Asp Pro Val Asn Val Tyr Gly Ala Pro Ile Glu Gly Asp
405 410 415

Met Ile Thr Thr Gly Thr Pro Leu Val Thr Pro Pro Leu Ile Asp Met
420 425 430

Ile Ser Asn Asp Pro Ile Leu Gly Gly Val Lys Leu Val Ala Glu Ala
435 440 445

Trp Asp Ala Gly Gly Leu Tyr Gln Val Gly Gln Phe Pro His Trp Asn
450 455 460

Val Trp Ser Glu Trp Asn Gly Lys Tyr Arg Asp Ile Val Arg Gln Phe
465 470 475 480

Ile Lys Gly Thr Asp Gly Phe Ala Gly Gly Phe Ala Glu Cys Leu Cys
485 490 495

Gly Ser Pro His Leu Tyr Gln Ala Gly Gly Arg Lys Pro Trp His Ser
500 505 510

Ile Asn Phe Val Cys Ala His Asp Gly Phe Thr Leu Ala Asp Leu Val
515 520 525

Thr Tyr Asn Asn Lys Tyr Asn Leu Pro Asn Gly Glu Asn Asn Arg Asp
530 535 540

Gly Glu Asn His Asn Leu Ser Trp Asn Cys Gly Glu Glu Gly Glu Phe
545 550 555 560

Ala Arg Leu Ser Val Lys Arg Leu Arg Lys Arg Gln Met Arg Asn Phe
565 570 575

Phe Val Cys Leu Met Val Ser Gln Gly Val Pro Met Phe Tyr Met Gly
580 585 590

Asp Glu Tyr Gly His Thr Lys Gly Gly Asn Asn Asn Thr Tyr Cys His
595 600 605

Asp Ser Tyr Val Asn Tyr Phe Arg Trp Asp Lys Lys Glu Gln Tyr Ser
610 615 620

Asp Leu His Arg Phe Cys Cys Leu Met Thr Lys Phe Arg Lys Glu Cys
625 630 635 640

Glu Gly Leu Gly Leu Glu Asp Phe Pro Thr Ala Glu Arg Leu Gln Trp
645 650 655

His Gly His Gln Pro Gly Lys Pro Asp Trp Ser Glu Asn Ser Arg Phe
660 665 670

Val Ala Phe Ser Met Lys Asp Glu Arg Gln Gly Glu Ile Tyr Val Ala
675 680 685

Phe Asn Thr Ser His Leu Pro Ala Val Val Glu Leu Pro Glu Arg Thr
690 695 700

Gly Arg Arg Trp Glu Pro Val Val Asp Thr Gly Lys Pro Ala Pro Tyr
705 710 715 720

Asp Phe Leu Thr Asp Asp Leu Pro Asp Arg Ala Leu Thr Ile His Gln
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